3-29-1996

UA3/8/5 Application for CAUSE Award for Excellence in Campus Networking

WKU President's Office-Meredith

— APPLICATION —

for the 1996 CAUSE AWARD FOR EXCELLENCE IN CAMPUS NETWORKING

☒ Category I: E&G under $100,000,000 ☐ Category 2: E&G over $100,000,000

Institution Name: Western Kentucky University

Name of Primary Campus Contact: Charles M. Anderson

Title: Assistant Vice President for Finance and Administration

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Institutional Enrollment (FTE): 11,112 Headcount: 14,721

Current Fiscal Year Institutional Educational and General (E&G) Budget: $89,111,700.00

Campuswide Networking Budget (voice, video, & data) for:

Personnel: 417,177 Hardware: 600,000 Software: 46,012

Maintenance: 130,000 Other: 20,000 Total Networking Costs: $4,036,000.00

Include: (1) an abstract (750 words or less), (2) a project description (maximum of five pages), and (3) supporting documents required to fulfill selection criteria listed.

I hereby certify that to the best of my knowledge the statements and descriptions contained in this application accurately reflect the circumstances on my campus.

Signature of primary campus contact: Charles M. Anderson

Signature of chief executive officer of the institution: Thomas C Meredith

Name and Title: Dr. Thomas C. Meredith, President

Note: by signing this application, the institution is granting CAUSE the right to duplicate and distribute this application in its entirety or in part.

Application Instructions. Completed applications must be received in the CAUSE office by April 1, 1996. Each application must identify a primary contact. All institutional characteristics should be based on current academic or fiscal year data. Please enclose both a printed and electronic copy (if available) of the abstract, project description, and supporting documents. CAUSE can receive electronic files via e-mail (rrichter@cause.colorado.edu), by anonymous ftp on the Internet, or on diskette (please specify software and version number).

Note: The application in its entirety should provide a model for other institutions to follow. Applications and project descriptions are made available to other institutions as part of a CAUSE Information Resources Library document.

Project Description

The Network

A computer network connection in every office, classroom, laboratory, and residence hall room, cable television service in every residence hall room, an academic cable system connecting all classrooms and laboratories, a computer on every faculty members' desk, seven general access student computer labs, and a campus wide local area network comprise the networked computing environment at Western Kentucky University -- WKUNET. This free, universal network access is provided as a basic educational utility.

Western Kentucky University's commitment and accomplishments in providing computing resources to its community of students, faculty, and staff is extraordinary, particularly in a regional, public university in a state which ranks 50th in funding for higher education. The networking accomplishments are the result of the vision and leadership of the University's President and Board of Regents, the confluence of several strategic planning processes, leveraging of existing construction projects to include network infrastructure, and creative financing which minimized the financial impact on the institution.

Two strategic planning processes, a comprehensive 1989/90 communications planning process and the University's 1990 strategic planning process, Western XXI, were principal catalysts in the network's development. The latter identified communications infrastructure and increased access to computing resources as critical to enhancing communications, increasing access to information, and improving instruction. Western XXI also recommended the creation of an Information Technology unit combining the disparate computing, telephone, media and public broadcasting organizations.

Construction of two new residence halls in 1992 required extension of the telephone system through fiber optic cables. This trenching project evolved into the first phase of a fiber and coaxial backbone for data, voice, and video. Another project to establish a University owned cable television service in the residence halls was expanded to include the fiber backbone along with the coaxial cable and the installation of twisted pair along with coax into each room. In essence, these two projects paid for trenching a major portion of the communications backbone and labor to pull twisted pair into the residence hall rooms.

Network development was also facilitated through a low interest master lease purchasing plan established in large measure to fund information technology projects. Over half of the network project was financed at terms of three years or five years (servers, network electronics, etc) to ten years (fiber and wiring). Debt is serviced from existing computer and telecommunications budgets.

All but a few University buildings are connected with 12 to 48 multimode optical fibers. Two buildings at the edge of campus are connected through WinData wireless RF links, and the Community College building and the University's conference center are connected through T-1 circuits. Four residence halls not wired with twisted pair now have network service through Zenith Homeworks RF cable modems.

The network is based on a semi-collapsed backbone design consisting of one Wellfleet BLN and two Wellfleet BCN routers on a 100 Mbps FDDI ring. One Wellfleet BCN router located on the south end of campus provides service to the south end of campus, which consists primarily of student residence halls and the main libraries. The second BCN, located in the telephone switch room at the north end of campus provides service to the majority of the academic classroom buildings as well as providing connections to

extended campus locations and the Internet. A smaller Wellfleet BLN router, located in the administration building, provides connectivity for the IBM mainframe and the centralized network servers. Each router provides the required Ethernet (FOIRL), Token Ring (FLE) or FDDI (DAS) connections to surrounding buildings utilizing 62.5/125um underground fiber.

Most of the 44 connected buildings are wired internally with enhanced category-5 UTP data cable, and have a UB Networks GeoLan/100 intelligent hub located in each of the primary wiring closets. Fourteen of the residence halls were wired in 1991/92 with category-3 cable. The network infrastructure includes a total of 63 of the GeoLan hubs providing secure 10BaseT connections to microcomputer users as well as Token-Ring and asynchronous connections for other functions in each building. In addition, a number of Access/Stax 16 and 24 port stackable hubs are used to provide Ethernet connectivity in low density areas and for temporary equipment setups. In total, the network includes 5,400 data/video outlets providing in excess of 14,000 data and video connections.

The network routes IP, IPX, AppleTalk and DECnet protocols, and source routes token-ring traffic between the IBM mainframe and token-ring attached terminal controllers in four buildings. The network is managed via SNMP using UB Networks NetDirector network management system. NetDirector provides a graphical view of the entire campus including extended campus locations and allows management down to the port level on each hub.

WKUNET was conceived as a comprehensive, easy to use, universal network which would unify and simplify the campus computing environment. It has been equally successful with both long time computing users and novices appearing to the user, and operating for all practical purposes, as one large local area network. A group of seven centralized Compaq 4500 Proliant servers operating with Novell 4.02 Netware (soon to be migrated to 4.11) and numerous associated gateways provide LAN services to approximately 1500 faculty and staff and over 500 student lab and residence hall machines. Some smaller servers are utilized for off campus locations and specialized groups.

The network front-end aggregates all computing services behind an innovative and easy to use graphical user interface designed and developed by University computing staff utilizing Visual Basic and C++ languages. Icons on this universal interface link users to electronic mail (Lotus cc:Mail for faculty and staff and VAX Mail for students), the library catalog, TOPCAT, the library's CD-ROM reference collection, mainframe applications including student, financial, and human resource systems for authorized users, the Internet using Netscape, a suite of microcomputer applications, windows based front ends for several text based mainframe systems, and a data warehouse. The warehouse is based on Microcoft's Sequel Server and a Focus client providing a menu of routine reports as well as user defined ad hoc queries from student records. Individual graphic interfaces have also been developed in Visual Basic for several of the older administrative systems.

Video networking includes WesternCable, a University owned and operated cable system serving all 18 residence halls with 28 channels of entertainment and information including three foreign language channels, a campus wide academic RF distribution system connecting all classrooms and laboratories, and an eleven site interactive video system utilizing VideoTelecomm equipment. An early adopter of distance learning, the University has been offering courses at extended campus locations since 1984 with a current annual enrollment of over 1500 students at those sites. Telephone service is provided by a University owned and operated AT&T Definity G2.2 digital switch serving 5,000 lines. An EPOS voice response system providing registration, drop-add, and grade reporting was implemented in the fall of 1995. Western also

operates an NPR affiliated public radio network serving more that 60% of the state plus southern Indiana and northern Tennessee, and a local PBS affiliated public television station, WKYU-TV.

Assessment

Although it is too early to conduct a formal assessment, WKUNET has been a resounding success. Faculty, students, and staff alike have expressed their appreciation for the service and its value in their work in glowing terms. The use of electronic mail as a means of speeding and improving communications and obtaining decisions on routine matters is quite evident. Much of this success is attributable to the fact that the University President and other leaders adopted the network as their mode of communication early in its development. Impact on instruction is increasingly evident. Access to the Internet's World Wide Web has been universally acclaimed as an invaluable resource. Many faculty are already utilizing the Web as an educational resource, and are developing course related web pages with local content and links to relevant external pages for their students. The use of e-mail between faculty and students is mushrooming. In addition to the 2000 connections to WKUNET, there are now over 5000 student e-mail accounts. Clearly, WKUNET is enhancing educational and administrative processes at Western Kentucky University. Moreover, our students will enter the marketplace better prepared to utilize computing technology as a result of their experiences with WKUNET. One faculty member recently characterized WKUNET as the one of the best things to happen for faculty during his tenure.

Financing

The residence hall portion of the video and data network, including a significant portion of the backbone, was financed through a long term, low interest Federal loan obtained for residence hall renovations. Remaining backbone segments and premises wiring were financed with fund balance allocations and existing computing and telecommunications budgets utilizing a combination of cash and three, five, and ten year lease/purchases. Most of the premises wiring was lease purchased over a ten year term at very favorable interest rates.

Total investment in the network, excluding the residence hall cable system and including backbone, premises wiring, central servers, software and related expenditures is approximately $3.3 million. Addition of the cable system brings the total data and video network project to about $4.0 million. By the end of 1995/96, the University will also have invested an additional $1.0 million in faculty and staff computers from central funds not including a large volume of departmental purchasing spurred in part by the network's completion.

The total investment has included:

Fiber and Coaxial backbone	429,937.00
Premises wiring	1,298,000.00
Network electronics	1,368,385.00
Central servers, software, etc	200,000.00
Sub total	$3,296,322.00
Residence hall cable system	740,000.00
Total	**$4,036,000.00**

Future Plans

Having "finished" the network in February of 1996, we fully recognize that it will actually never be completed. Plans are already underway for improvements. Connection of the extended campus centers with the same functionality available on campus will be completed by the fall of 1996. The campus wide LAN will be migrated to Novell 4.11 by the summer of 1996. Additional functions and software will be added on a continuing basis. Lotus's cc:Mail for the Web was recently added to provide easy off campus access for faculty and staff. The University has also out-sourced remote access to MCI by purchasing PPP Internet accounts for all faculty and staff who desire to take advantage of it.

An upgrade to a more robust e-mail system providing the potential for all 14,000+ students to have active accounts and a GUI POP mail client is planned by the fall of 1996. Introduction of an ATM segment to handle the compressed video traffic is planned in the near future with the eventual migration of the entire backbone to ATM. Ethernet switching and 100 Mbps segments will be introduced as demand dictates.

We believe that video server technology is mature enough for the implementation of an instructional video on demand system on the academic cable system and eventually via the data backbone. At some point, the addition of desktop videoconferencing is anticipated. The migration to client server has already begun with the data warehouse and the implementation of a client server institutional advancement system planned for 1996/97. Full migration to client server is planned within a three to five year time frame.

Strengths and Weaknesses

The network's strength is that it is ubiquitous, technically robust, current in its technology, and that it provides a standard computing environment for all faculty staff and students on campus. At this juncture we have not experienced a major weakness. Performance has been excellent. Although it would have been desirable to contract the design and construction of the entire network as a single project, we estimate that we have saved one to three million dollars by designing it in house and benefitting from the increasingly competitive bids for the five phases of the project. The one principal regret/ weakness is the fact that in the early stages of the project we did not include substantial spare conduit. Although space is quite adequate for our foreseeable needs, in the later stages we added at lest two empty 4 inch conduits for future use.

Historical Summary

In 1990, there were a few departmental labs on campus internally networked with thin wire Ethernet and Novell 3.11. Mainframe computing was accessed by some 500 terminals through a myriad of old copper and coax. Various labs and two buildings were networked with a combination of AppleTalk, Arcnet, DECnet, and thin wire Ethernet. There were no standards or centralized network services. Networking was essentially an anarchy. Only two segments of fiber had been installed to provide mainframe computer connectivity with no inclusion of video or provision for expansion. The two computing areas reported to two different vice-presidents.

Beginning with the 1990 Communications Strategic Plan and culminating in the formation of a single information technology organization reporting to an assistant vice president, the move to a unified networking environment began. Construction of the infrastructure began with the residence hall cable project and evolved into the campus wide network. The concept of WKUNET, a single LAN serving to aggregate easy access to all networking services, was originally a LAN for two administrative buildings designed to replace

an aging WANG word processing system with the vision that it would scale up to become the University's network. It did.

Once the President and the Board of Regents established networking as a top priority, the primary difficulty was getting the various phases designed in sufficient detail to be processed through the state of Kentucky's capital construction process. We purposely evaded the assignment of an external engineering firm to avoid the one to two year delay that would have caused and some problems we had previously experienced with outside "help". Most of our problems were a result of limited internal resources. We could not hire new network personnel fast enough to relieve existing personnel to concentrate on planning and design of the network, and the University's one architect was overwhelmed with other projects. Another significant delay was caused by one contractor missing its project deadline by three months. Surprisingly, funding was not a problem. In the final analysis, we are quite pleased to have migrated from the antiquated Wang system serving only two buildings and a terminal based mainframe environment with about 500 users to a ubiquitous and powerful network environment serving the entire University community with over 2,000 nodes in a less than three years time.

Abstract

The University president promptly responds to electronic mail from the campus community. A biology professor downloads an animated model of viruses from the Internet for use in class and on the course's Web page. In a computer lab across campus, a freshman English major accesses the library's catalog and CD-ROM reference collection to begin her research for a paper on southern writers. From his residence hall room, a senior communications student browses the Internet for the latest developments in advanced television, writes his report and submits it to his professor via electronic mail. All are becoming commonplace at Western Kentucky University as a result of the completion of WKUNET in February of 1996.

Universal network access is provided at Western Kentucky University as a basic educational utility. The University's commitment to its development was catalyzed and intensified by two strategic planning processes beginning with a comprehensive 1989 communications planning process and continuing in the University's 1990 strategic planning process, Western XXI. The latter identified communications infrastructure and increased access to computing resources as critical to enhancing communications, increasing access to information, and improving instruction.

All aspects of WKUNET, including servers, fiber and wiring, and network electronics card, has been centrally funded based on an institutional value that the entire University community, regardless of budget resources, should have access to computing resources. Its development was also facilitated by adding backbone installation to other underground projects and utilizing creative financing. Over half of the total network cost was financed at terms of three years to ten years through a master lease/purchase program established in large measure to fund information technology initiatives with debt serviced from existing budgets.

WKUNET provides connectivity from every residence hall room, office, laboratory, and classroom. All but a few University buildings are connected with multimode fiber optic cable and coaxial hard line for RF distribution. Two buildings at the edge of campus are connected through wireless RF links. The Community College building and an off campus conference center are connected through T-1 circuits. Most premises wiring is enhanced category 5 unshielded twisted pair and RG-6 coax. Residence halls were wired in 1992 with category 3, although four of the 18 buildings not wired with twisted pair now receive data service through Zenith cable modems. A total of 44 buildings are wired.

The fiber backbone operates at 100 Mbs utilizing the FDDI protocol and all intra building connections currently operate in 10 BaseT ethernet. WKUNET appears to the user and operates for all practical purposes as one large local area network. A group of Compaq Proliant 4500 centralized servers operating with Novell Netware 4.02 provide LAN services to approximately 1500 faculty and staff and more than 500 student lab and residence hall machines. Some smaller servers are utilized for off campus locations and other specialized groups.

WKUNET aggregates all computing applications on a single network with an easy to use graphical front end. Developed by University computing staff, its Icons link users to electronic

mail (Lotus cc:Mail and Vax Mail for students) , the library's NOTIS circulation system, the library's CD-ROM reference collection, mainframe applications, including student, financial, and human resources systems for authorized users, the Internet, and a standard suite of microcomputer applications -- Word Perfect, Lotus's 1-2-3, Approach, and FreeLance Graphics. GUI front ends have also been developed for several legacy mainframe applications. A recently implemented data warehouse, based on Microsoft's SQL Sequel Server database and Focus for Windows client, provides routine reports and ad hoc analyses of student data.

Video networking includes WesternCable, a University owned and operated cable system serving all 18 residence halls, a campus wide academic RF distribution system connecting all classrooms and laboratories, and an eleven site interactive video system utilizing VideoTelecomm equipment. An early adopter of distance learning, the University has been offering courses at extended campus locations since 1984 with a current annual enrollment of over 1500 students at distant sites. Telephone service is provided by a University owned and operated AT&T Definity G2.2 digital switch serving 5,000 lines. Western also operates a public radio network and a local public television station.

Although it is too early to conduct a formal assessment, the anecdotal evidence is overwhelmingly positive. The impact of electronic mail as a means of speeding and improving communications and decisions on routine matters is quite evident. Impact on instruction is also increasingly evident. One faculty member recently characterized WKUNET as the one of the best things to happen for faculty during his tenure.


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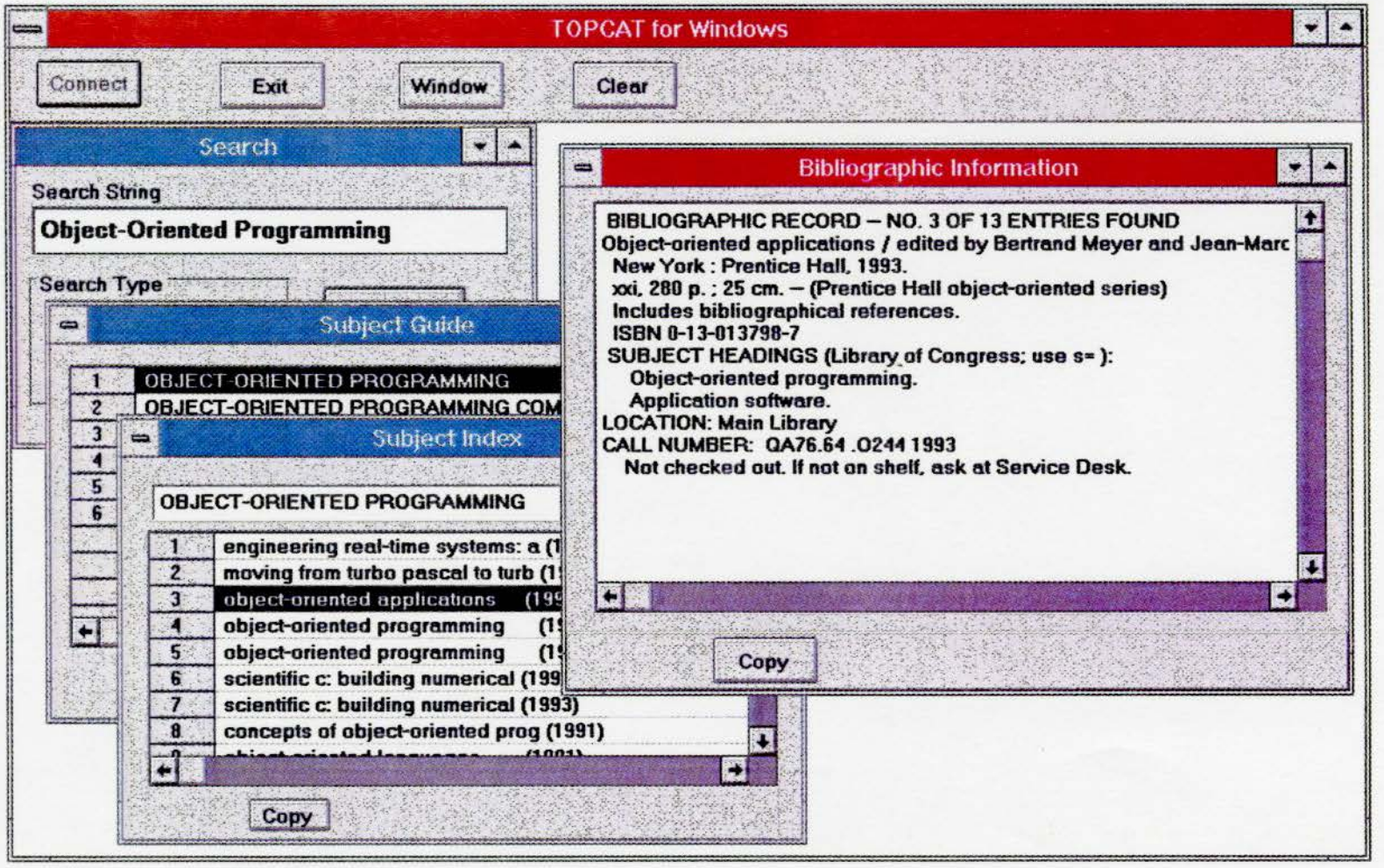
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Object-oriented applications / edited by Bertrand Meyer and Jean-Marc
New York : Prentice Hall, 1993.
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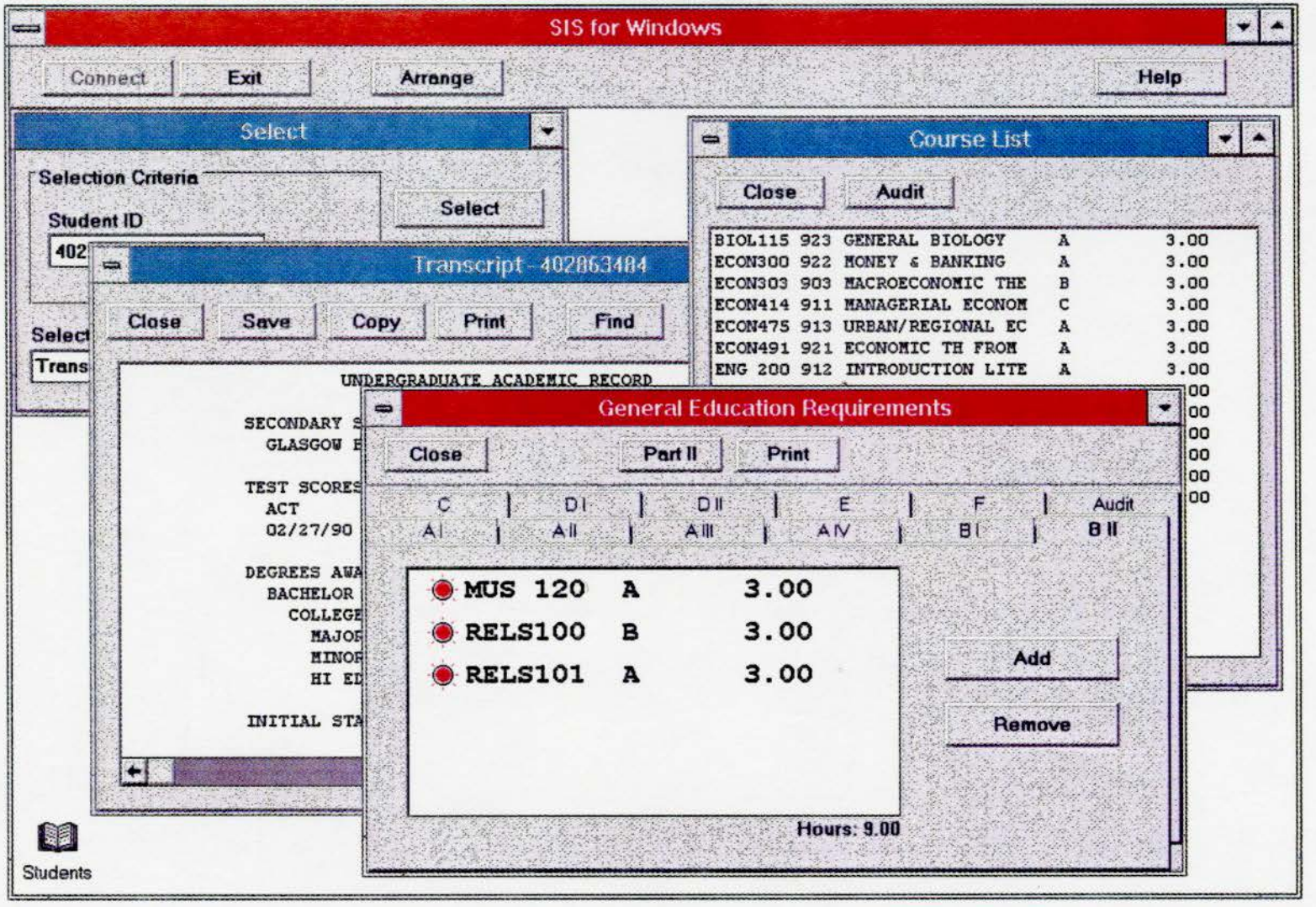
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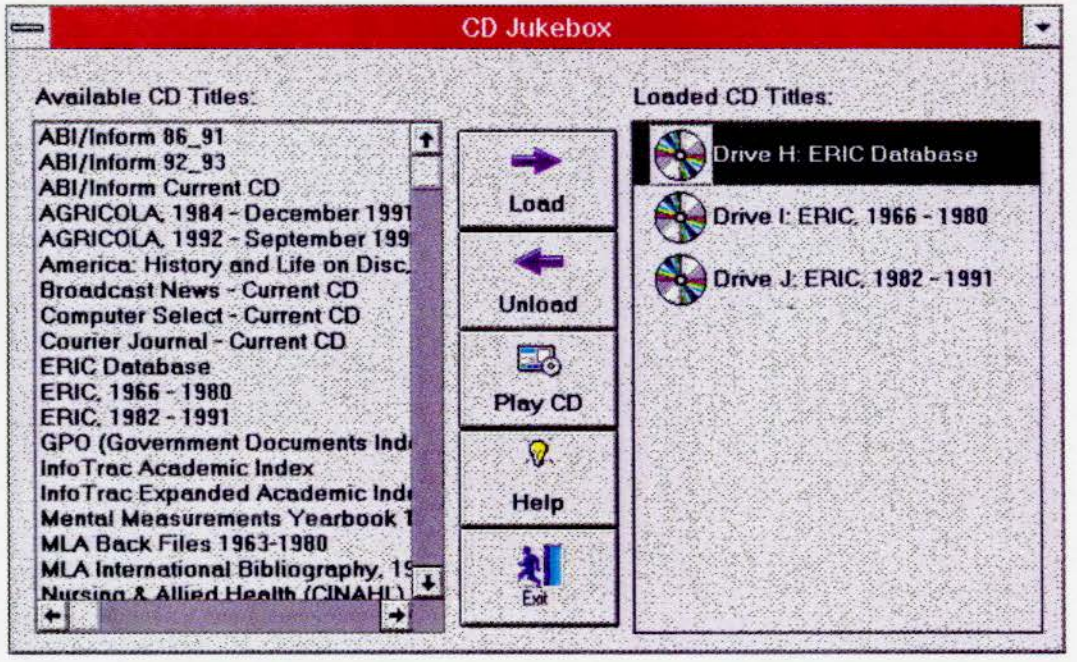
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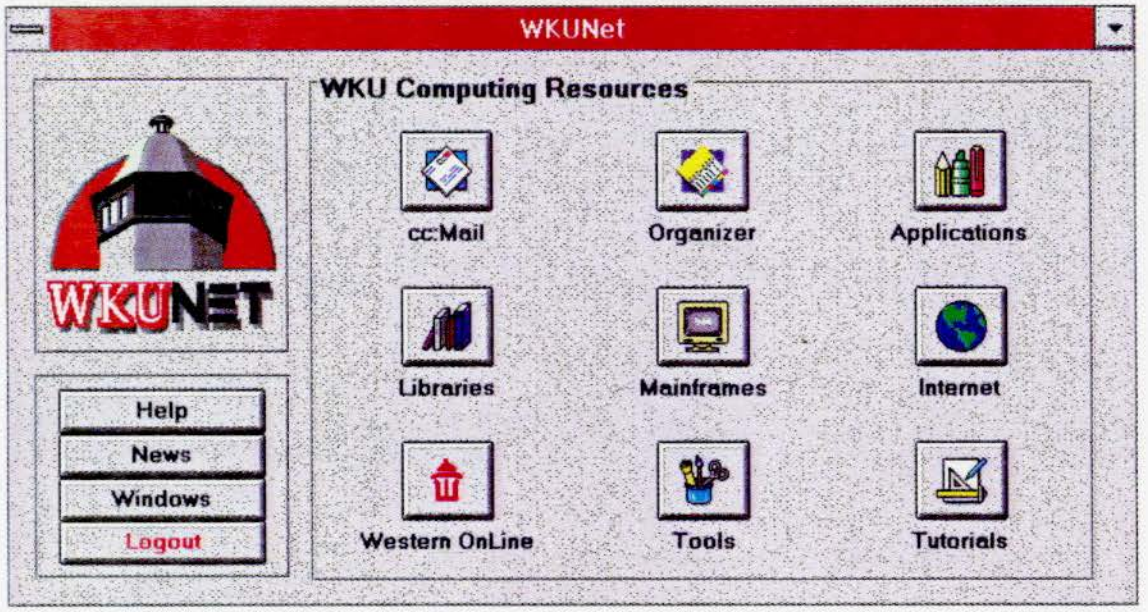
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